

A Critical Review of Models and Theories in Field of Individual Acceptance of Technology

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Abstract

Information systems and technology have become essential tools for organizations to achieve their goals. Therefore, many technology acceptance theories and models have been developed in the field. Research showed a number of models that introduce the factors which make information systems successful. Based on the theoretical lens rooted in the literature, the researchers critically reviewed ten models and theories on individual acceptance of technology. The review identifies the major models to make explicit assumptions. The present study tries to provide a summary of strengths and weaknesses that have been discussed about these models and theories.

Keywords: *Models and Theories, Individual Acceptance, Technology, Information Systems.*

1. Introduction

Previous research shows that selecting an appropriate theory or model has always remained a critical task for IS researchers. To the best of the authors' knowledge, there are few papers that review and compare the acceptance theories and models at the individual level [1]. Hence, this study aims to compare the most important theories and models in field of individual acceptance.

According to Venkatesh *et al.* [2] there are eight models and theories in the field of individual acceptance. Those models and theories are TRA, SCT, TAM, TPB, MPCU, MM, C-TAM-TPB, and IDT. According to Kim and Crowston [3] there are a good number of theories and models employed in studying individuals' ICT adoption and post-adoption behaviors such as TRA, TAM, TPB, TAM2, IDT, SCT, and UTAUT. According to Oliveira and Martins [4] the most used theories in field of technology adoption are TAM, TPB, UTAUT, DOI Theory and TOE. DOI and TOE Framework are at the firm level. The TAM, TPB and UTAUT are at the individual level. According to Al-Mamary [5] there are many theories in field of acceptance of the technology such as TAM, IS success model, computer usage model, personal computing acceptance model. According to Al-Mamaery *et al.* [6] the most popular models in the field of information systems success, and technology adoption such as the technology acceptance model and information system success model focuses on the technology factors of the successful implementation of information systems. In addition computer usage model focuses on people factors and organizational support. In addition, personal computing acceptance model focuses on the organizational factors.

This paper tried to indicate the strengths and weakness that are discussed in the literature.

2. Models and Theories of Individual Acceptance of Technology

2.1. Theory of Reasoned Action (1980)

The Theory of Reasoned Action (TRA) was developed by (Fishbein and Ajzen [7]; Ajzen and Fishbein, [8]). TRA is one of the most fundamental and influential theories of human behavior. It has been used to predict a wide range of behaviors [2].

The intention to accept or reject a particular technology is based on a series of tradeoffs between the perceived benefits of the system to the user and the complexity of learning or using the system. This phenomenon can be reasonably explained by using the theory of reasoned action. In short, TRA proposes that individual beliefs influence attitudes, hence creating intentions that will generate behavior [9].

According to Kurland [10] Theory of Reasoned Action (TRA) is concerned with consciously intended behaviors and links behavioral intention to the person's actual behavior. The person's attitude toward the behavior coupled with the subjective norm concerning the behavior (*i.e.*, assessing whether the respondent believes that others who are important to them think they should do X and whether they want to comply with these wishes), determines the behavioral intention. Figure 1 depicts the theory.

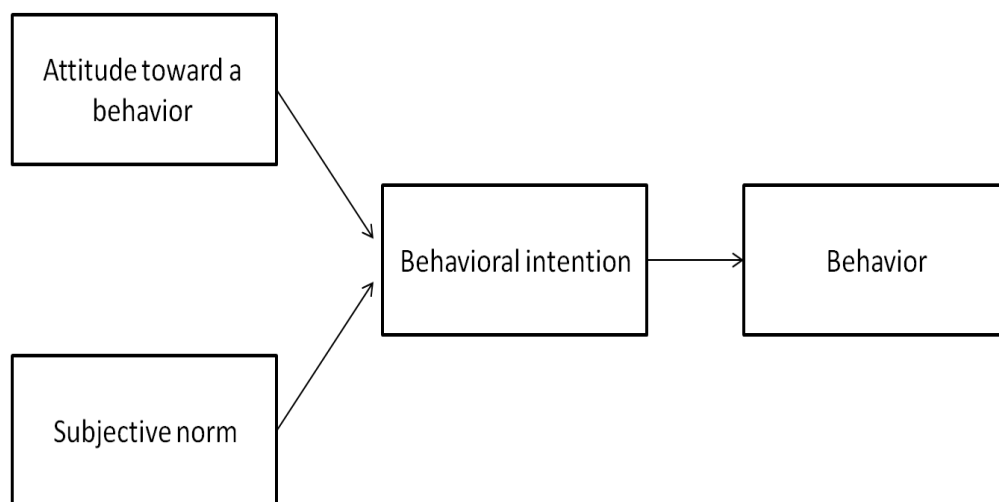


Figure 1. Theory of Reasoned Action (TRA) (Ajzen & Fishbein, [8])
Source: Madden *et al.* [11]

Fishbein and Ajzen [7] defined attitude towards behavior as an individual's positive or negative feelings (evaluative effect) about performing the target behavior. Subjective norm is the person's perception that most people who are important to him think he should or should not perform the behavior in question. According to Ramayah and Jantan [9] the subjective norms reflect the person's perception of social pressures put on him/her to perform or not to perform the behavior in question. Subjective norms are a function of normative beliefs. In other words, a person who believes that most people with whom he/she is motivated to comply think he/she should perform the behavior will perceive social pressure to do so.

In summary, there are many researchers applying Theory of Reasoned Action (TRA) in various academic disciplines. This researcher realized that this theory was not sufficient and there were several limitations. According to Kurland [10] TRA is limited because it assumes that actions are totally under volitional control. This assumption fails to acknowledge that individuals' behaviors may be directed, for example, by systemic constraints. According to Davis *et al.* [12] Theory of Reasoned Action (TRA) is very general. According to Baraghani [13] TRA is a general model that does not specify the

beliefs that are operative for a particular behavior. Researchers using TRA must first identify the beliefs that are salient for subjects regarding the behavior under investigation.

To address these limitations, Ajzen in 1991 extended the TRA and proposed a new theory called Theory of Planned Behavior (TPB) by adding the variable perceived behavioral control. According to Kurland [10] TPB predicts that the stronger the agent's perceived behavioral control, the more likely the agent will intend to perform the behavior.

2.2. Social Cognitive Theory (1986)

Many theories have been proposed over the years to explain the developmental changes that people undergo over the course of their lives. These theories differ in the conceptions of human nature they adopt and in what they regard to be the basic causes and mechanisms of human motivation and behavior [14]. Social Cognitive Theory (SCT) was developed by Bandura [14]. The SCT defines human behavior as a triadic, dynamic and reciprocal interaction of personal factors, behavior and the environment (See Figure 2). According to this theory, an individual's behavior is uniquely determined by each of these three factors. While the SCT upholds the behaviorist notion that response consequences mediate behavior, it contends that behavior is largely regulated antecedently through cognitive processes. Therefore, response consequences of a behavior are used to form expectations of behavioral outcomes. It is the ability to form these expectations that give humans the capability to predict the outcomes of their behavior before the behavior is performed. In addition, the SCT posits that most behavior is learned vicariously.

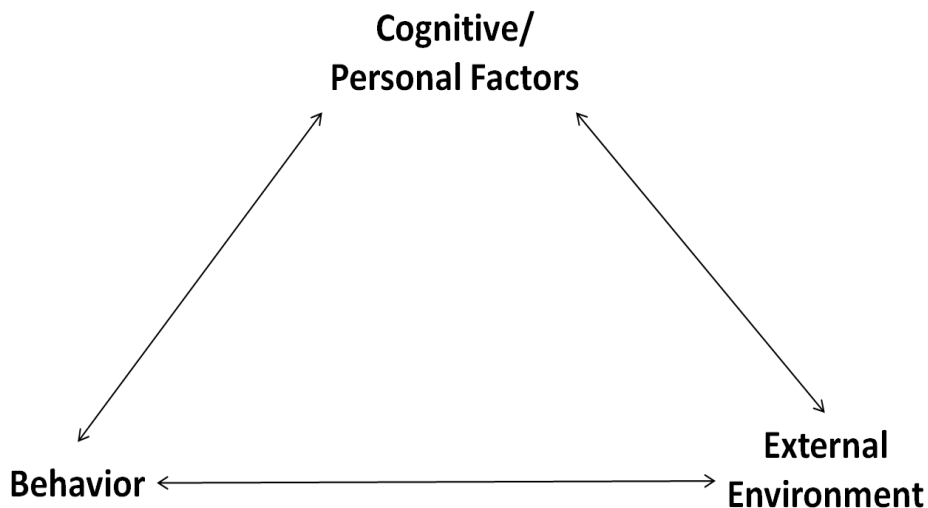


Figure 2. Social Cognitive Theory (Bandura, [14])
Source: Wood and Bandura [15]

According to Venkatesh *et al.* [2] Social Cognitive Theory (SCT) is one of the most powerful theories of human behavior. SCT have five core constructs: outcome expectations performance, outcome expectations personal, self-efficacy, effect and anxiety. Compeau and Higgins [16] defined outcome expectations performance as the performance-related consequences of the behavior. Specifically, performance expectations deal with job related outcomes. Abbad [17] defines self-efficacy as interpreted as one's self-confidence in his or her ability to perform certain tasks using a system. Venkatesh *et al.* [2] defines effect as an individual's liking for a particular behavior (*e.g.* computer use). Igbaria and Iivari [18] define computer anxiety as the

tendency of an individual to be uneasy, apprehensive and/or phobic towards current or future use of computers in general.

In summary, Social Cognitive Theory (SCT) applied to a wide spectrum of areas of study such as human functioning as career choice, athletics, organizational behavior and mental and physical health. It has also been used in the areas of behavior in the classroom including motivation, learning, and achievement [19]. According to Abbasi [20] Social Cognitive Theory (SCT) provided ground-breaking concepts of self-efficacy, experience, time to study, training and social influence (later on used as subjective norms), but the theory itself cannot be generalized easily. SCT can be used as an umbrella to extend its concepts and constructs into a specific model and purpose but applying the theory itself is a very difficult task. As described earlier, SCT is not a theory specifically designed for observing human behavior in specific areas but it is general and broad in context so it can be widely applied in many diverse areas, such as computer utilization, Internet usage and gratification.

Social cognitive theory is organized based on the dynamic interplay between person, behavior and environment. It is unclear the extent to which each of these factors into actual behavior and if one is more influential than another. Social cognitive theory can be used to extend its concepts but applying the theory itself is a very difficult task. In addition, this theory is more related to education and motivation.

2.3. Technology Acceptance Models

The most common technology acceptance model reviewed by previous researchers is TAM. According to Surendran [21] Technology Acceptance Model is one of the most popular research models to predict use and acceptance of information systems and technology by individual users. According to Agrawal [22] Technology Acceptance Model is one of the most influential models widely used in the studies of the determinant of IS/IT acceptance. Technology Acceptance Model (TAM), developed by Davis *et al.* [12] is one of the most influential research model to determinate the level of IS adoption at the individual level. The main variables in TAM is perceived ease of use and perceived usefulness. Figure 3 depicts the theory.

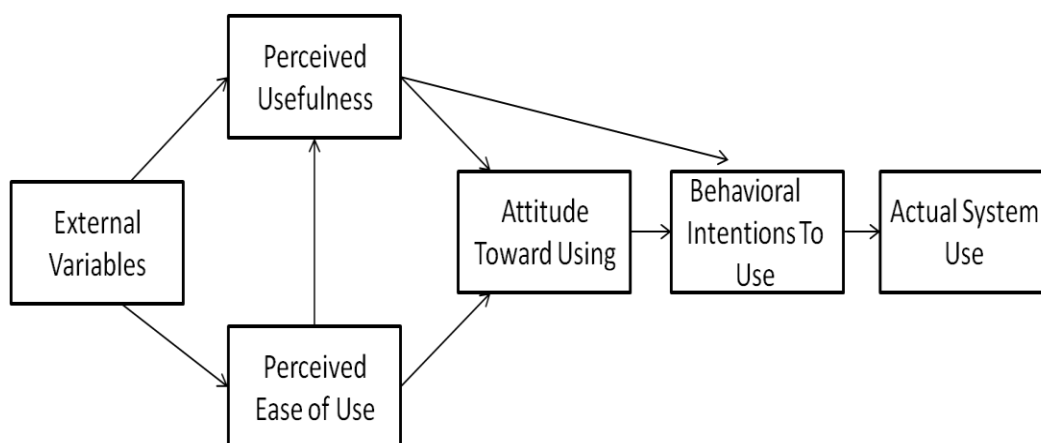
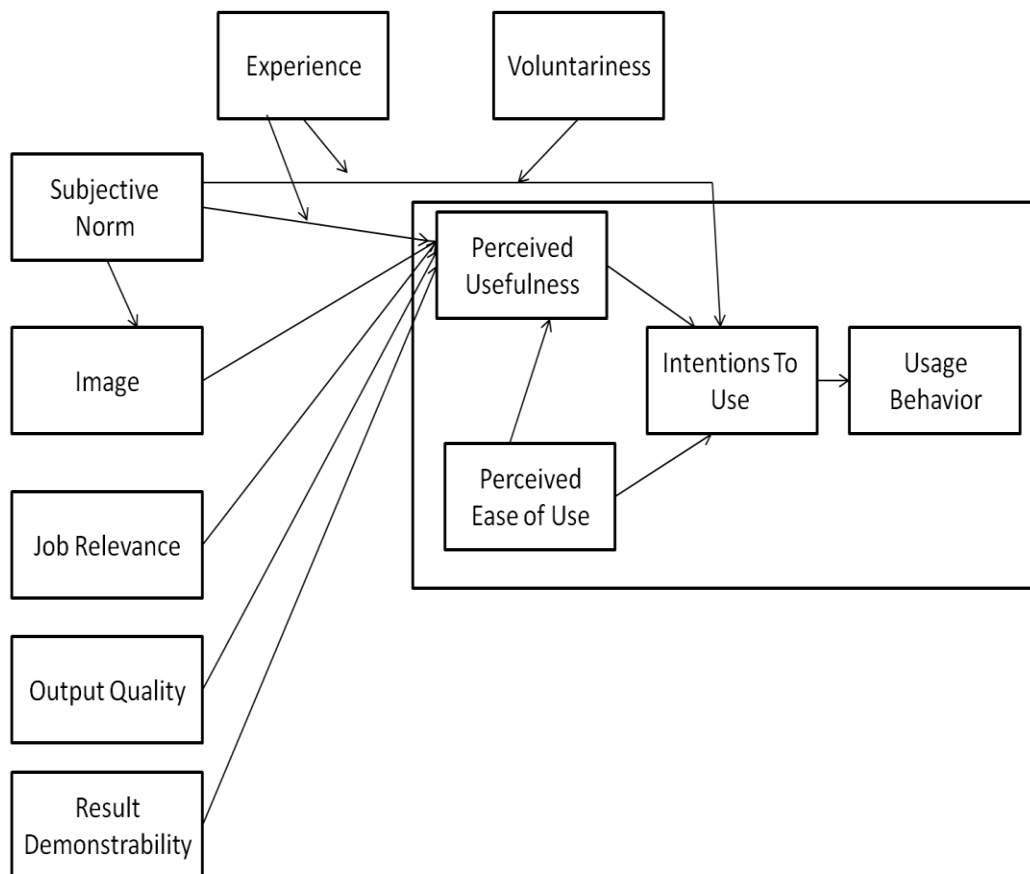


Figure 3. Technology Acceptance Model (Davis *et al.*, [12])
Source: Davis *et al.* [12]

Perceived usefulness was defined by Davis [12] as "the degree to which a person believes that using a particular system would enhance his or her job performance". People tend to use or not to use an application to the extent they believe that it will help them to perform their job better.

Meanwhile perceived ease of use explains the user's perception of the amount of effort required to utilize the system or the extent to which a user believes that using a particular technology will be effortless [12]. According to Petter *et al.* [23]; Seddon and Kiew [24]; Delone and Mclean [25]; Hwang *et al.* [26]; Petter and McLean [27] ease of use is a measure of the system quality. Hence, some of researchers includes ease of use as a measure of the system quality.

In 2000, Technology Acceptance Model 2 (TAM2) (as illustrated in Figure 4) was developed by Venkatesh and Davis [28] on the basis of Technology Acceptance Model (TAM). Two processes, the social influence processes (Subjective Norm, Voluntariness and Image) and the cognitive instrumental processes (Job Relevance, Output Quality, Result Demonstrability and Perceived Usefulness) were integrated into this model. The two processes were considered to be crucial to the study of user acceptance [29]. According to Wu and Wang [30]. the results of the research by Venkatesh and Davis [28] indicated that perceived usefulness, perceived ease of use and subjective norm all indirectly influence actual system use through behavioral intention. In other words, behavioral intention is jointly determined by perceived usefulness, perceived ease of use and subjective norm. Subjective norm is the direct and significant determinant of perceived usefulness while perceived ease of use has a small but significant impact on perceived usefulness.



**Figure 4. Technology Acceptance Model 2 (TAM 2)
 (Venkatesh and Davis, [28])
 Source: Venkatesh and Davis [28]**

In 2003, Unified Theory of Acceptance and Use of Technology (UTAUT) (as illustrated in Figure 5) was developed by Venkatesh *et al.* [2] on the basis of Technology Acceptance Model (TAM), Motivational Model, the Theory of Planned Behavior, a

model combining the Technology Acceptance Model and the Theory of Planned Behavior, the Model of PC Utilization, the Innovation Diffusion Theory and the Social Cognitive Theory Toward a unified view.

UTAUT has four key constructs (*i.e.*, performance expectancy, effort expectancy, social influence, and facilitating conditions) that influence behavioral intention to use a technology and/or technology use. According to UTAUT, performance expectancy, effort expectancy and social influence are theorized to influence behavioral intention to use a technology, while behavioral intention and facilitating conditions determine technology use [31].

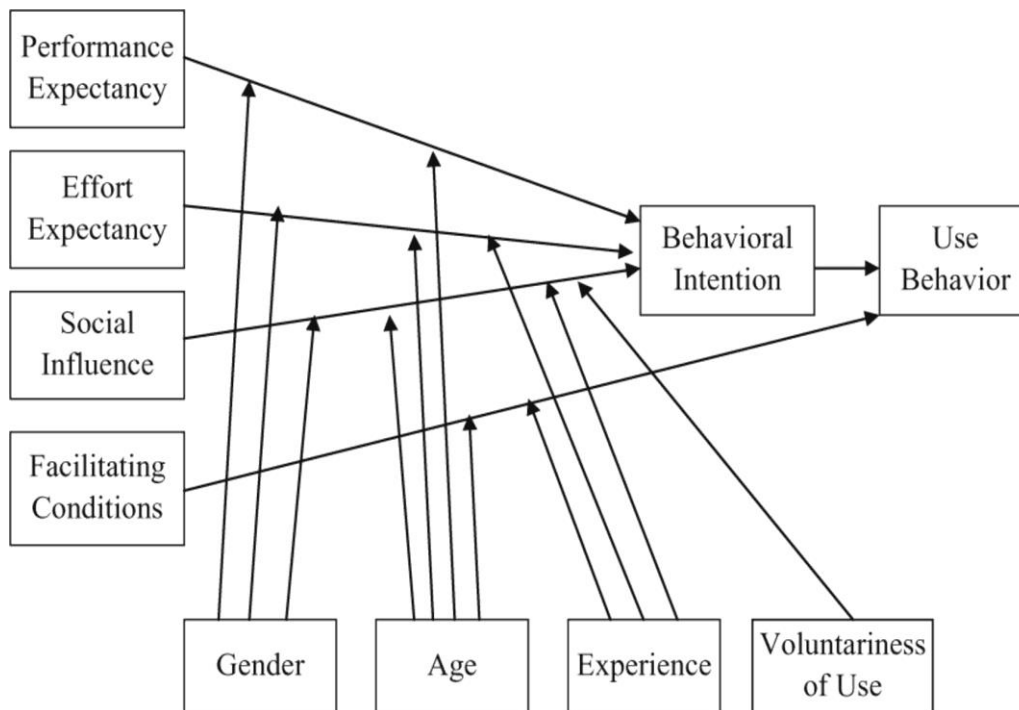
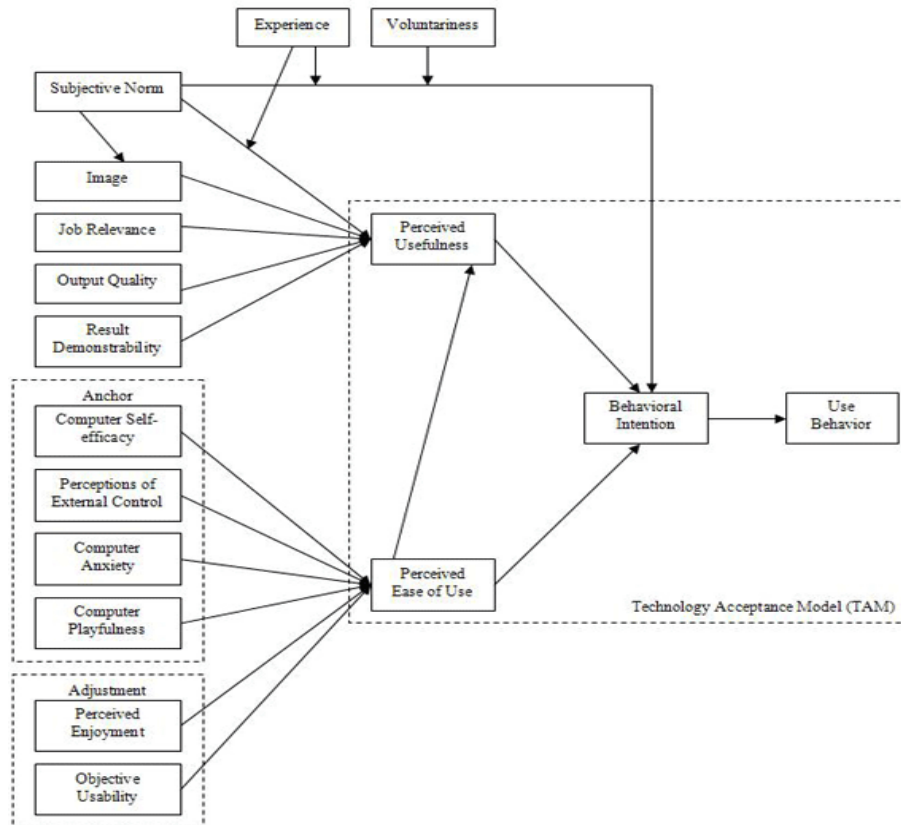


Figure 5. Unified Theory of Acceptance and Use of Technology (UTAUT)
(Venkatesh *et al.*, [2])
Source: Venkatesh *et al.* [2]

Venkatesh and Bala [32] combined TAM2 (Venkatesh and Davis, [28]) and the model of the determinants of perceived ease of use (Venkatesh, [33]) to develop an integrated model of technology acceptance TAM3, shown in Figure 6. TAM3 presents integrated model of the determinants of individual level (IT) adoption and use. Technology Acceptance Model 3 (TAM3) posits three relationships that were not empirically tested in Venkatesh [33] and Venkatesh and Davis [28]. Venkatesh and Bala [32] suggest that experience will moderate the relationships between (1) perceived ease of use and perceived usefulness; (2) computer anxiety and perceived ease of use; and (3) perceived ease of use and behavioral intention.

TAM3 (Venkatesh and Bala, [32]) is based on a theoretical framework consisting of four categories the authors say are a synthesis of all previous TAM research. Each of the four categories: individual differences (Computer Self Efficacy, Computer Anxiety, Computer Playfulness); system characteristics (Job Relevance, Output Quality, Result Demonstrability, Perceived Enjoyment, Objective Usability); social influence (Subjective Norm, Image); and facilitating conditions (Perception of External Control) are made up of their own variables based on the two main determinants of PU and PEOU [34].



**Figure 6. Technology Acceptance Model 3 (TAM3)
 (Venkatesh and Bala, [32])
 Source: Venkatesh and Bala [32]**

In summary, Technology Acceptance Model (TAM) suggests that when a new technology is presented to the users, the users decide when and how they will use the technology based on a number of factors: perceived usefulness and perceived ease-of-use. Note that use or acceptance of the technology in some cases needs another factor such as: information quality, top management support and computer self-efficacy *etc.* According to Abugabah *et al.* [35] previous research had used system usage and user satisfaction to measure system success and the TAM variables to predict usage of information systems. However, researchers later on suggested that TAM variables may be insufficient predictors of system usage and success. What is important is they used user performance or what is sometimes called individual impact as an indicator to system success or system effectiveness. Al Haderi [36] mentioned that information quality could enhance the employee's intention to use or adopt the technology when they see it is useful. According to Chen and Hsiao [37] for IS acceptance, top management should focus on providing sufficient support. According to Ragu-Nathan *et al.* [38] top management support gives significant impact on the information systems performance. Aktag [39] claimed that computer self-efficacy is the most essential factor related to computer usage. Therefore, there are several aspects to encourage the end-user to accept or use the technology.

Moreover, TAM2, TAM3 and UTAU assume that the user of the system volunteers to use the system. Voluntary use environment mean users believe that they have a choice in the technology adoption or use decision. But in some cases use of the system is mandatory. In addition, Unified Theory of Acceptance and Use of Technology (UTAUT) does not include individual factors that may help explain information system acceptance [40].

2.4. Technology, Organization, and Environment Framework (1990)

Technology, Organization and Environment (TOE) Framework was developed by Tornatzky and Fleischer [41]. It identifies three aspects of an enterprise's context that influence the process by which it adopts and implements a technological innovation: technological context, organizational context and environmental context. The Technology, Organization and Environment (TOE) as originally presented, and later adapted in IT adoption studies, provides a useful analytical framework that can be used for studying the adoption and assimilation of different types of IT innovation (Oliveira and Martins, [4]). Figure 7 depicts the theory.

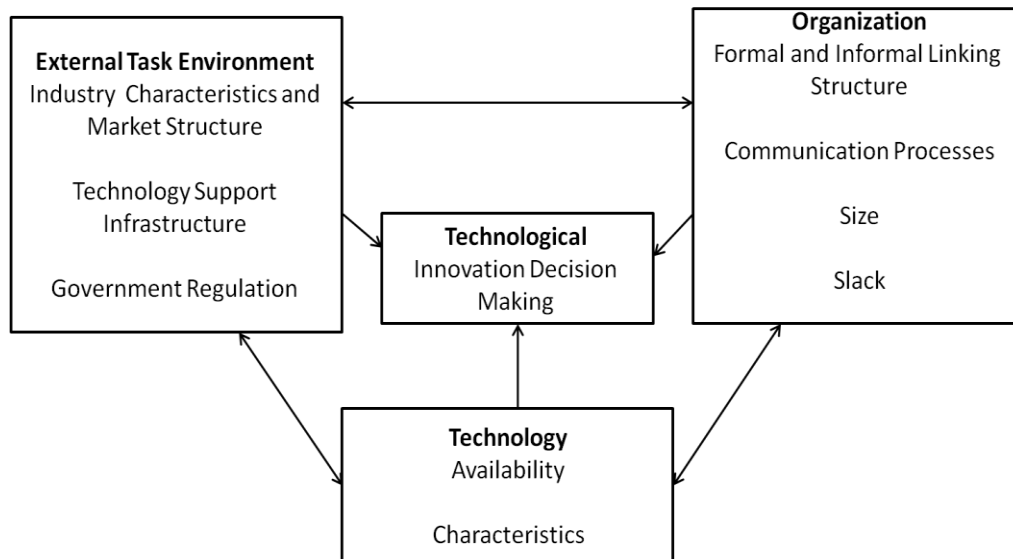


Figure 7. Technology, Organization, and Environment Framework (Tornatzky and Fleischer, [41])
Source: Tornatzky and Fleischer [41]

According to Tornatzky and Fleischer [41] the technological context includes the internal and external technologies that are relevant to the firm. Technologies may include both equipment as well as processes. The organizational context refers to the characteristics and resources of the firm including the firm's size, degree of centralization, degree of formalization, managerial structure, human resources, amount of slack resources and linkages among employees. The environmental context includes the size and structure of the industry, the firm's competitors, the macroeconomic context and the regulatory environment.

In summary, TOE framework is focused technology (availability and characteristics), organization (formal and informal linking structures, communication processes, size and slack), and environment (industry characteristics and market structure, technology support infrastructure and government regulation). But these factors are not consistent with the other researchers. Al-Busaidi and Al-Shihi [42] developed a theoretical framework for acceptance of learning management systems in Oman. This framework provides a comprehensive look at the critical factors. These critical factors are related to the instructor, organization and technology. Technology factors can be related to the system quality, information quality and service support quality. Organization factors can be related to motivation, technology alignment, organization support, technical support and training. Instructor factors can be related to self-efficacy, attitude toward systems, experience, teaching style and personal innovativeness. User characteristics can be related to age, education, IS experience, user involvement & participation and training. Organizational characteristics can be related to top management support, organizational

culture and business process reengineering. According to Yusof *et al.* [43] human, organization and technology are the essential components of IS; the impacts of HIS are assessed in the net benefits. Technology factors can be related to the system quality, information quality and service support quality. Human factors can be related to system use and user satisfaction. Organization factors can be related to structure and environment.

2.5. Theory of Planned Behavior (1991)

The Theory of Planned Behavior (TPB) is an extension of the Theory of Reasoned Action (TRA) (Ajzen and Fishbein [8]; Fishbein and Ajzen [7]) made necessary by the original model's limitations in dealing with behaviors over which people have incomplete volitional control [44].

The Theory of Planned Behavior (TPB) is one of the most widely cited and applied behavior theories. It is one of a closely inter-related family of theories which adopt a cognitive approach to explaining behavior that centres on individuals' attitudes and beliefs. The TPB posits intention to act as the best predictor of behavior. Intention is itself an outcome of the combination of attitudes towards a behavior. That is the positive or negative evaluation of the behavior and its expected outcomes and subjective norms are the social pressures exerted on an individual resulting from their perceptions of what others think they should do and their inclination to comply with these. The TPB added a third set of factors as affecting intention (and behavior); perceived behavioral control. This is the perceived ease or difficulty with which the individual will be able to perform or carry out the behavior and is very similar to notions of self-efficacy [45].

According to Venkatesh *et al.* [2] the Theory of Planned Behavior (TPB) extended the theory of reasoned action (TRA) by adding the construct of perceived behavioral control. In the TPB, perceived behavioral control is theorized to be an additional determinant of intention and behavior.

According to Egmond and Bruel [46] the model of the Theory of Planned Behavior, attitudes, subjective norms and perceived behavioral control predict the intention which in turn predicts the behavior. Background variables as demographic factors, are supposed to influence the behavior through the three determinants and the intention. Attitudes, subjective norms and the perceived behavioral control, explain the behavioral intention before the behavior takes place. The intention is a good predictor of the actual behavior. Theory also says that the perceived behavioral control is an estimate of the skills needed for expressing the behavior and the possibility to overcome barriers. Therefore, a direct influence of perceived behavioral control on behavior is supposed. The actual behavior leads to feedback about the expectations of the behavior. In addition, the model of the theory of planned behavior assumes that consumers make decisions by calculating the costs and benefits of different courses of action and choosing the option that maximizes their expected net benefits.

The TPB has been applied to a wide range of behaviors in order to better understand which individuals behave in which way. It is one of the best-supported social psychological theories with respect to predicting human behavior [47]. Figure 8 depicts the theory in the form of a structural diagram.

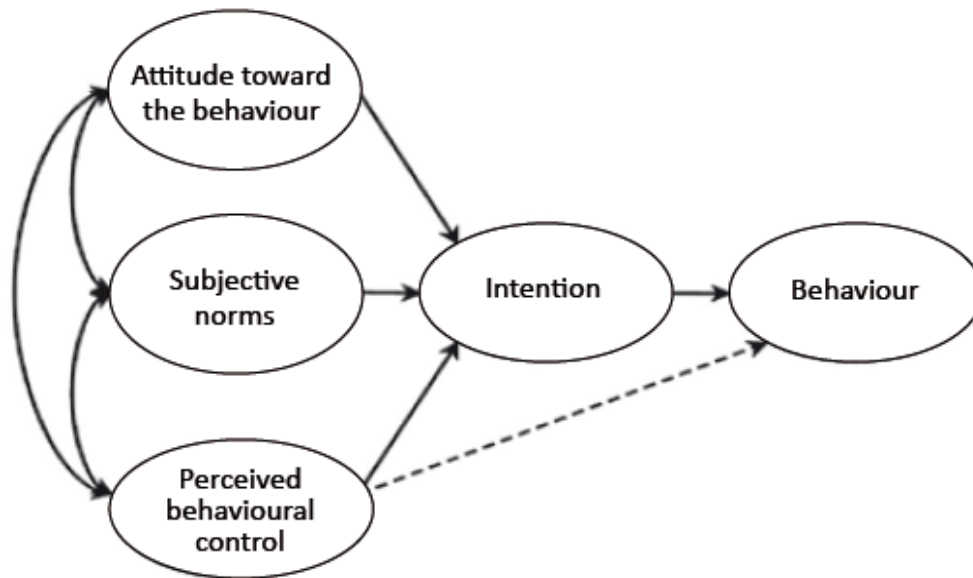


Figure 8. Theory of Planned Behavior (Ajzen, [44])
Source: Ajzen [44]

According to Ajzen [44] perceived behavioral control relates to the extent to which the person believes that he has control over personal or external factors that may facilitate or constrain the behavioral performance.

In 1995, TAM-TPB Model was developed by Taylor and Todd [48]. In a more complex approach, Taylor and Todd [48], combined TAM-TPB model the predictors from TAM and TPB model, such as, attitude toward behavior (adapted from TRA/TPB), subjective norm (adapted from TRA/TPB), perceived behavioural control (adapted from TPB), and perceived usefulness (adapted from TAM) in their studies of assessing IT usage [49]. According to the combined TAM-TPB Model, behavior is influenced by behavioral intention, which, in turn, is influenced by attitude, subjective norm, perceived behavioral control, and perceived usefulness. The C-TAM-TPB also predicts that perceived behavioral control will have a direct effect on behavior in addition to its indirect effect through intentions. Perceived usefulness and perceived ease of use are determinants of attitude, whereas perceived ease of use directly affects perceived usefulness [50].

Taylor and Todd [48] posited that the relationships among the constructs appearing in combined TAM-TPB Model would be moderated by user experience. Their empirical study substantiated this assumption since the impact of perceived usefulness, attitude, and perceived behavioral control on behavioral intentions was stronger in case of users with relatively more experience. In contrast, the impact of subjective norm was attenuated under high levels of experience. An apparent implication of Taylor and Todd's study is that when firms design and implement an IT system, they should take into account the user's level of experience since less experienced users will tend to rely on different factors (*e.g.* perceived usefulness) than experienced ones in order to start using the system [50]. Figure 9 depicts the theory in the form of a structural diagram.

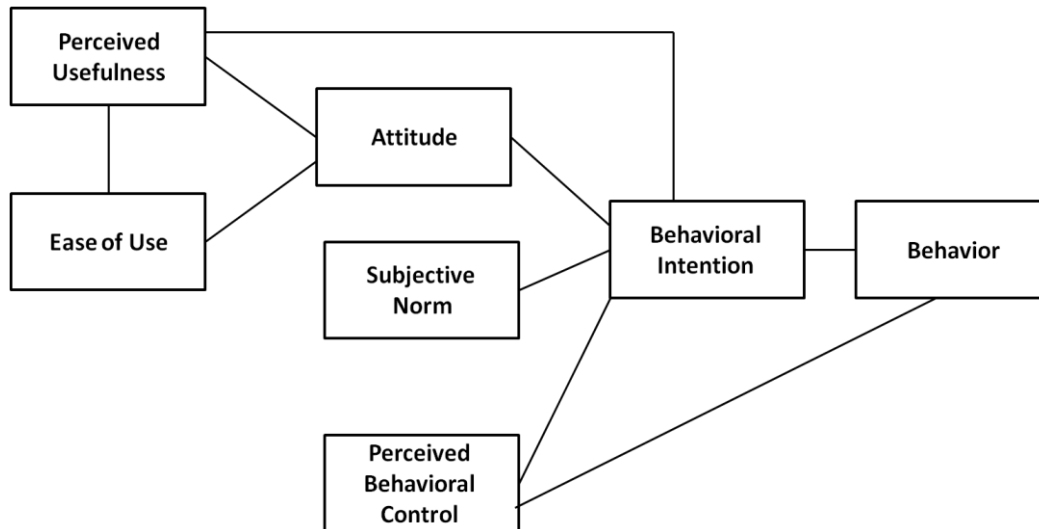


Figure 9. Combined TAM-TPB (Taylor and Todd, [48])
Source: Taylor and Todd [48]

In summary, the main assumption of theory of reasoned action (TRA) and theory of planned behavior (TPB) is that individuals are rational in considering their actions and the implications of their actions (decision-making). The theory of planned behavior mainly focuses on the intention and behavior. According to Egmond and Bruel [46] the model of the Theory of Planned Behavior assumes that consumers make decisions by calculating the costs and benefits of different courses of action and choosing the option that maximizes their expected net benefits. The theory of Planned Behavior belongs to the so-called group of ‘rational choice models’. But in some cases the use of the system is compulsory. The users don’t have options to use the system or not. This means this theory is more suited as an optional choice only.

2.6. Diffusion of Innovation (DOI) Theory (1995)

The theory of adoption and diffusion of innovations is a useful systemic framework to describe either adoption or non adoption of new technology. Diffusion occurs progressively within one market (a system of users) when information and opinions about a new technology are shared among potential users through communication channels. In this way, users acquire a personal knowledge about new technology. Knowledge is the first step of Rogers’ five stages process of adoption. The other four steps are: persuasion, decision (to adopt or to reject new technology), implementation and confirmation. Accepting this framework, non adoption can be explained as the final outcome of an individual process of adoption that failed. Rogers argues that a great number of conditions (*e.g.* personal limitations of the potential user) and/or external obstacles (*e.g.* ineffective communication channels) may inhibit the success of the adoption process [51].

Diffusion of innovations is a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures. Diffusion is the process in which an innovation is communicated through certain channels over time among members of a social system. It is a special type of communication in that the messages are concerned with new ideas. The four main elements in the diffusion of innovations are the innovation, communication channels, time and the social system [52].

According to Rogers [53] the perceived attributes of an innovation are one important explanation of the rate of adoption of an innovation. From 49 to 87 percent of the variance in rate of adoption is explained by five attributes: relative advantage, compatibility,

complexity, trial ability and absorbability. Figure 10 shows the variables that determining the rate of adoption innovations.

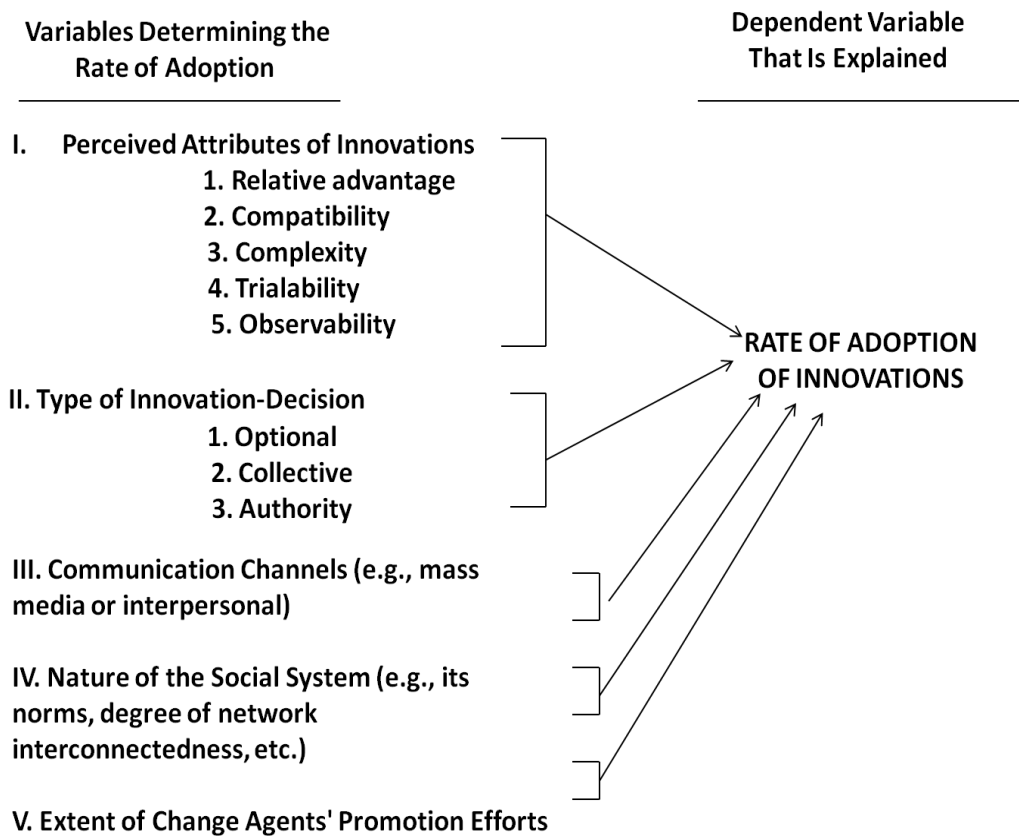


Figure 10. Variables Determining the Rate of Adoption Innovations (Rogers, [53])
Source: Rogers [53]

In summary, Diffusion of Innovations (DOI) Theory is often simplified to focus solely on a product or innovation, disregarding the complex societal, cultural, economic and other factors that determine how the product is adopted into society. According to Ward [54] there have been many attempts to explore model of diffusion of innovations; however the model have weaknesses in predicting the behavior of individuals and organizations. According to Oliveira and Martins [4] Diffusion of Innovation (DOI) Theory are at the firm level and not for the individual level.

In addition, Diffusion of Innovations (DOI) Theory is more related to higher education and educational environments. According to Medlin [55] Roger's diffusion of innovations theory is the most appropriate for investigating the adoption of technology in higher education. Moreover, diffusion of innovation (DOI) theory misses some important facets in the diffusion of complex technologies. Therefore DOI researchers should carefully recognize the complex, networked and learning intensive features of technology. In addition, DOI theory does not offer adequate constructs to deal with collective adoption behaviors [56].

From the previous researchers, we can summarized that, (1) DOI theory focus solely on a product or innovation and ignore other factors that determine how the product is adopted, (2) DOI have weaknesses in predicting the behavior of individuals, (3) DOI theory does not offer adequate constructs to deal with collective adoption behaviors, and

(4) DOI more related to educational environments. Diffusion of Innovation (DOI) Theory users must decide to adopt or reject new technology. But in some cases the users had no choice because the technology was already adopted. This means this theory is more suited as an optional choice only.

3. Conclusion

This paper made a review of literature of technology acceptance models at the individual level. Ten models in field of individual acceptance of technology have been critically reviewed. These models and theories are: Theory of Reasoned Action (TRA), Social Cognitive Theory (SCT), Technology Acceptance Model (TAM), Technology Acceptance Model 2 (TAM2), Unified Theory of Acceptance and Use of Technology (UTAUT), Technology Acceptance Model 3 (TAM3), Technology, Organization, and Environment Framework (TOE), Theory of Planned Behavior (TPB), Combined TAM-TPB, and Diffusion of Innovation (DOI). The study is also potentially useful as it showed the strengths and the weakness in each model. This can provide a robust opportunity to future researchers to adopt suitable models to conduct empirical tests in different technology settings.

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